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Pacific Herring Stocks and Fisheries in the Arctic-Yukon-Kuskokwim Region of the Northeastern Bering Sea, Alaska, 1991

A Report to the Alaska Board of Fisheries

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INTRODUCTION

The objectives of this report are to summarize the results of the 1991 herring stock assessment programs for the Arctic-Yukon-Kuskokwim (AYK) Region, review and evaluate 1991 harvests and management strategies for all AYK commercial herring fishing districts and the Yukon-Kuskokwim River Delta subsistence fishery, and present general management strategies for the AYK herring fishing season in 1992. Commercial fishing districts included in this report are the Security Cove, Goodnews Bay, Cape Avinof, Nelson Island, Nunivak Island, Cape Romanzof, Norton Sound, and Port Clarence Districts (Figures 1 and 2).

The 1991 herring harvest for the AYK Region was approximately 7,357 tons with a total estimated ex-vessel value of $3,028,000 (Tables 1 and 2). Food and bait sales during the sac roe fishery totaled 364 tons, with the remaining harvest sold for sac roe product. Harvest identified as food and bait primarily occurs during the sac roe fishery when fish are sold with a roe content that is below buyer's acceptable minimums. A total of 668 fishermen participated in AYK sac roe herring fisheries during the 1991 season (Table 3). Fishing effort has been declining since a historic high of 1,195 fishermen was reached in 1987. The closure of some districts has contributed to this decline but the primary cause is a moratorium placed on entry into the Nelson Island, Nunivak Island, Cape Romanzof, and Norton Sound herring fisheries. The Commercial Fisheries Entry Commission is currently in the process of issuing limited entry permits for these fisheries. All AYK Region commercial herring districts, except Security Cove and Port Clarence, are designated as superexclusive use areas.

There were no commercial openings in the Nelson Island and Port Clarence Districts during 1991. The estimated biomass of herring in the Nelson Island District was less than the 2,500 tons threshold necessary for a commercial fishery. There has been no commercial fishing in the Port Clarence District since 1988 because buyers have not been present in the district.

Average roe recovery of the sac roe harvest ranged from 7.4% in the Nunivak Island District to 9.5% in the Cape Avinof District with a regional average of 9.2%. Exploitation rates (the percentage of the biomass harvested) were low in all AYK herring districts in 1991. Exploitation rates ranged from 1.5% in the Nunivak Island District to 13.5% in the Norton Sound District (Table 2).

Surveyed subsistence fishermen from selected Yukon-Kuskokwim River Delta villages harvested approximately 78 tons of herring (Table 4).

The total estimated herring biomass of 64,546 tons for the surveyed portion of the AYK herring districts was 16% higher than the 1990 estimate of 54,258 tons and is similar in magnitude to the 1988 biomass (Table 2). Within the past ten years, the 1991 herring biomass ranks second only to the 1988 biomass in size. This is due to a record biomass of herring observed in the Norton Sound District in 1991. Norton Sound herring comprised 66.4% (Figure 3) of the regional total

in 1991 and was dominated by age 9 herring. Ages 7 and 8 were the dominant age groups for other AYK stocks. Recruits (ages 3, 4, and 5) accounted for 7.9% of the Norton Sound biomass compared with 9.8% for non-Norton Sound stocks. For the first time in several years, a significant percentage of recruit herring was observed in the Security Cove and Goodnews Bay Districts.

STOCK STATUS

Assessment Methods

Aerial surveys were flown throughout the spawning season in all commercial fishing districts to determine the relative abundance, timing, distribution, and biomass of Pacific herring. Occurrence and extent of milt, numbers of fishing vessels, and visibility factors affecting survey quality were also recorded. Data collection methods were similar to those used since 1978. Historically, it has been difficult to obtain biomass estimates from aerial surveys in this area due to poor survey conditions caused by unfavorable weather, presence of ice and turbid water.

During 1991, a total of 110 aerial surveys were conducted in the AYK region; 15 in Security Cove, 15 in Goodnews Bay, 9 in Cape Avinof, 18 in Nelson Island, 15 in Nunivak Island, 8 in Cape Romanzof, 20 in Norton Sound, 2 in Port Clarence and 8 in the Jacksmith Bay (central Kuskokwim Bay) area. Over half of these surveys were flown under poor to unacceptable survey conditions. More surveys were flown in 1991 than in any year since 1985 due to a temporary increase in funding for aerial surveys in the Kuskokwim Area.

Standard conversion factors of 1.52 tons (water depths of 16 ft or less), 2.58 tons (water depths between 16 and 26 ft) and 2.83 tons (water depths greater than 26 ft) per 538 ft^2 of surface area were used to convert observed herring school surface areas from aerial surveys to biomass within all districts (Lebida and Whitmore 1985).

Herring from test and commercial fishery harvests were sampled in all but the Port Clarence District to estimate age, sex, size, and gonad maturity of herring and to note the occurrence of other schooling fishes. Approximately 14,400 herring from commercial and test catches were sampled from seven of the eight AYK herring districts during the 1991 fishing season.

In most districts, fishermen, in cooperation with the Department, provided catch samples for roe quality evaluation by industry representatives. Participation by fishermen in collecting samples, processor evaluation of samples, and the flexibility of fishermen to fish on short notice aided in obtaining optimum roe recoveries.

Ground surveys were conducted in some districts to obtain information on the distribution and density of kelp beds and herring spawn deposition.

Spawning Populations

Security Cove District

Since 1981, the estimated biomass of herring in the Security Cove District has ranged from 2,300 tons in 1987 to 8,300 tons in 1981. During 1991, 15 aerial surveys were flown in the district from May 5 to June 5 to estimate herring biomass and spawning activity. Three-fourths of these surveys were flown under poor or unacceptable survey conditions. Herring were first seen in the Security Cove District on May 9. The season's largest biomass of 2,940 tons was observed during an aerial survey flown under good conditions on May 13. A second peak of 1,494 tons was sighted during a May 24 survey. The total biomass of herring in the district was estimated to be 4,434 tons by combining these surveys. A total of 11.3 miles of spawn was observed in the district with peak spawning activity occurring on May 12.

Department test fishing was conducted from May 10 to May 27 using variable mesh gill nets. Approximately 959 herring from test nets were sampled for biological data. A sample of 286 herring was taken from the commercial harvest.

In 1991, ages 8, 7, and 4 dominated the return in both biomass and numbers of fish. Age 9 and older herring comprised 43.5% of biomass (Figure 4a). Recruits, ages 4 and 5 herring, represented 35.4% of the return in numbers of fish (Figure 5). This is the largest herring recruitment observed in the Security Cove District since the large 1978 year class was observed as five-year-olds in 1983.

Goodnews Bay District

Since 1981, the estimated biomass of herring in the Goodnews Bay District has ranged from 2,000 tons in 1987 to 4,479 tons in 1988. In 1991, 15 aerial surveys were flown from May 6 to June 5 in the Goodnews Bay District. Three-fourths of these were flown under poor to unacceptable conditions. Herring were first sighted in the district on May 6 and spawning activity was first documented by the Department test fish crew on May 11. During a May 13 aerial survey, 1,548 tons of herring were observed in the district. On a June 5 survey, 317 tons of herring were counted. Two miles of spawn were sighted during a May 13 aerial survey.

It appears that the total biomass of herring present in the district was greater than that observed on aerial surveys. The commercial fishery's catch per unit of effort during 1991 was a historic record for the Goodnews Bay District. In the Security Cove District, the estimated biomass from aerial surveys was nearly three times the preseason biomass projection. Department test fish samples contained a significant number of recruit herring in both the Security Cove and Goodnews Bay Districts. Given the close proximity of Security Cove and Goodnews Bay and the similar recruitment in both districts, it is assumed that the actual biomass of herring in Goodnews Bay was greater than the projected biomass by approximately the same amount as in the Security Cove District. Under this assumption, the Goodnews Bay biomass was estimated to be 4,387 tons.

A total of 1,634 herring were sampled for age, length, weight and sex data from variable mesh gill nets from May 6 to June 5. A total of 241 herring were sampled from the commercial harvest.

In 1991, age 7 herring dominated the biomass; however age 4 herring dominated in numbers of fish (Figure 4a). Half of the biomass was age 9 and older herring. Recruits, ages 3, 4, and 5 herring, represented 27.4% of the return in numbers of fish (Figure 5).

Cape Avinof District

Aerial surveys have been conducted by the Department in the Cape Avinof area since 1985. Herring biomass observations of 2,000 tons, 1,225 tons, and 4,110 tons were made in 1985, 1987, and 1988, respectively. Weather conditions in 1986 and 1990 and ice conditions in 1989 precluded biomass estimates by aerial survey. In 1991, six of the nine aerial surveys of the Cape Avinof District were flown under acceptable conditions. A total of 1,879 tons of herring were documented on a May 24 survey. An additional 204 tons were seen on June 6 during an aerial survey. The total biomass of herring in the Cape Avinof District was estimated to be 2,083 tons by combining these two surveys. No spawn was observed during aerial surveys.

A total of 1,139 herring were sampled for age, sex, length, and weight data from variable mesh gill nets from May 23 to June 12. A total of 474 herring were sampled from the commercial harvest.

Ages 7 and 8 herring represented 18.2% and 15.1% of the run by weight (Figure 4a). Age 9 and older herring comprised 46.5% of the biomass. Younger herring, ages 3, 4 and 5, represented approximately 28.7% of the return in numbers of fish (Figure 5).

Nelson Island District

Since 1985, biomass observations of herring in the Nelson Island District have ranged from 2,385 tons in 1990 to 9,500 tons in 1985. During the 1991 herring season, 18 aerial surveys were flown between May 13 to June 6. Ten of these surveys were flown under acceptable survey conditions. During an aerial survey on May 17, 819 tons of herring were observed. During aerial surveys on May 24 and June 4, 889 tons and 676 tons of herring were observed. Due to differences in age composition between Department test fish samples collected around May 24 and June 4, the fish seen on May 24 were judged to be different from those seen on June 4. The total herring biomass estimate in the Nelson Island District of 2,385 tons was obtained by combining the three surveys. Ten miles of spawn were observed during aerial surveys.

A Department test fish crew sampled 1,326 herring in variable mesh gill nets from May 19 to June 18 for biological analysis. A total of 186 herring were sampled from subsistence catches.

Age 7 herring represented 18.1% of the 1991 biomass (Figure 4a). Fifty-five

percent of the biomass consisted of age 9 and older herring. Recruits, ages 3, 4 and 5, comprised 19.5% of the return in numbers of fish (Figure 5).

Nunivak Island District

Since 1985, the estimated biomass in the Nunivak Island District has ranged from 422 tons in 1990 to 6,000 tons in 1986. During 1991, fifteen aerial surveys were flown between May 13 and June 4. Twelve of these surveys were flown in fair to excellent survey conditions. During aerial surveys on May 19 and May 28, 3,237 tons and 666 tons of herring were counted. These two surveys were combined producing a biomass estimate of 3,902 tons for the district. Nearly 24 miles of spawn was documented during aerial surveys with peak spawning (10.1 miles) observed on May 21.

Department test fishing was conducted from May 15 to June 4 using variable mesh gill nets. Approximately 579 herring from test nets were sampled for biological analysis. A total of 135 herring were sampled from the commercial harvest.

Age 11 herring comprised 22.4% of the return (Figure 4b). Seventy-eight percent of the biomass consisted of age 9 and older herring. Younger fish, ages 3, 4, and 5 herring, represented 11.1% of the run in numbers of fish (Figure 5).

Cape Romanzof District

Since 1980, the estimated biomass of herring in the Cape Romanzof District has ranged from 3,000 tons in 1980 to 7,500 tons in 1986. Due to excessive water turbidity in the Cape Romanzof area, it is generally not possible to estimate herring biomass from aerial surveys. Biomass has been estimated using information from test and commercial catches, spawn deposition, and age composition. In 1991, eight aerial surveys were flown from May 14 to May 24. A total of 3.5 hours were spent surveying the district. A survey flown under poor conditions on May 20 documented a biomass of 705 tons. A total of 2.25 miles of spawn was observed along the north shore of Kokechik Bay. Surveys were flown along the coast to Hooper Bay, in Scammon and Kokechik Bays, and several miles offshore of the cape in an attempt to observe schools of herring. However, all surveys were unacceptable due to poor weather and turbid water conditions.

Daily spawn deposition surveys in the Kokechik Bay area of the Cape Romanzof District began on May 14. On May 16, the first observations of spawn were recorded. The initial spawn deposition was considered to be quite extensive and thick for a first spawn, averaging from 1 to 2 egg layers in areas where spawning occurred on *Fucus* substrate. A gradual increase in spawn deposition followed both in layers of eggs and distribution. Spawn deposition on *Fucus* substrate peaked May 22-23, with an average of from 2 to 4 egg layers depending on location. Spawn deposition on rock substrate peaked May 28 to 29 with an average of 1 to 2.8 egg layers. The last survey was conducted on June 4.

Since it was not possible to estimate the biomass inseason, the projected biomass of 3,000 tons was used to manage the fishery. However the biomass estimate was adjusted postseason to 4,500 tons after evaluating commercial and test fish catch

rates and spawn deposition data.

Department test fishing was conducted from May 15 to June 6 using variable mesh gill nets. A total of 2,137 herring were caught, of which 1,248 herring were sampled for biological data. A total of 641 herring were sampled from the commercial harvest.

Twenty-five percent of the biomass was composed of age 7 herring (Figure 4b). Age 9 and older herring comprised 56% of the biomass. Recruits, ages 3, 4, and 5 herring, represented only 3.2% of the biomass and 6.2% of the return in numbers of fish (Figures 4b and 5).

Norton Sound District

Historically, the primary spawning areas within Norton Sound have been from Stuart Island to Tolstoi Point. Additional spawning areas have been documented along Cape Denbigh and several bedrock outcroppings along the northern shore of Norton Sound between Bald Head and Topkok especially in years when sea ice has remained in the nearshore areas into June.

Herring biomass estimates in the Norton Sound District has fluctuated from 5,300 tons in 1978 to 42,853 tons in 1991. During 1991, 20 surveys were flown on nineteen different days, from May 8 to June 10, for a total of nearly 56 hours of aerial survey time. Aerial survey conditions were predominantly fair. The first survey flown, by the Department, was May 15. However, a small biomass of herring were reported by a pilot on May 13. Ice floes hampered aerial surveys until May 21 and covered the preferred spawning area until May 26 when ice began to retreat from east to west over the following three days. On May 22, industry spotters reported herring spawning at Egg and Besboro Islands. Water temperatures at the Islands were quite warm in comparison to the normal spawning areas which were still iced in. Samples of herring taken on May 22 and 23 indicated that virtually all the herring in nearshore waters were ripe with no immature or spawned fish. Apparently cold water associated with the ice prevented the mature herring from spawning and caused fish to pool as they waited for the water to warm. Old age herring composed the bulk of the biomass observed nearshore through May 27.

Spawning began on May 25 in earnest with the peak day of spawning recorded on May 27. On May 27, a large biomass of herring was observed on the spawning grounds; however poor weather did not allow another survey to be conducted until June 3. At that time it become evident that the biomass was appreciably larger than the preseason projection. A postseason examination of aerial survey observations, herring movement patterns, and test fishery data resulted in a biomass estimate of 42,854 tons. The final complete survey of Norton Sound was flown June 7 exhausting aerial survey funds. A total of 30.2 linear miles of spawn was sighted during aerial surveys.

Two Department test fishing projects operated during the 1991 season. One project was located at Cape Denbigh in northern Norton Sound. A second crew was stationed at Klikitarik, in southern Norton Sound. Test fish crews sampled 3,269 herring caught with variable mesh gill nets for age, sex, length and weight data.

A sample of 1,303 herring was taken from the commercial catch.

Age 9 herring comprised 31.8% of the 1991 biomass (Figure 4b). The biomass consisted of 65.1% age 9 and older herring. Recruits, ages 3, 4 and 5 represented 7.9% of the biomass and 14.7% of the return in numbers of fish (Figures 4b and 5).

Port Clarence District

Generally, it is not possible to survey this district due to ice, water stain, and poor weather. In addition, it is difficult to identify herring due to the large numbers of saffron cod, whitefish, and other pelagic species typically present in the area. In 1991, two aerial surveys were flown and were rated unacceptable because of poor water clarity.

SUBSISTENCE FISHERY

Pacific herring are an important component of the diet of residents of many Yukon-Kuskokwim Delta villages. Surveys of subsistence harvests have been conducted annually in Yukon Delta villages and sporadically in Kuskokwim Delta villages since 1975. The total catch reported from surveys or mailed questionnaires should be considered minimum levels of effort and harvest since not all fishing families are contacted nor return completed questionnaires.

Extensive subsistence surveys were conducted by Subsistence Division in the Nelson and Nunivak Island Districts in the Kuskokwim Area in 1990 and 1991 (Pete 1990, 1991). This effort was prompted by concern over expected low returns of herring to these districts. A total of 71 tons of herring was harvested for subsistence by 85 Nelson Island fishing families in 1991. This is the lowest subsistence herring harvest reported by Nelson Island residents since intensive surveys started in 1986. Twenty fishing families in the village of Mekoryuk on Nunivak Island harvested 4 tons of herring. A more detailed description of the 1991 subsistence fishing season for Nelson and Nunivak Islands is available in a separate report to the Alaska Board of Fisheries by Subsistence Division (Pete 1991).

During 1991, 196 subsistence herring survey questionnaires were mailed to known subsistence fishing families in the Yukon Delta villages of Hooper Bay, Chevak and Scammon Bay. Approximately 4 tons of herring was reported as having been harvested by 30 fishing families (Table 4).

COMMERCIAL FISHERY

Security Cove District

The commercial herring fishery in the Security Cove District has been regulated by emergency order since 1981 to provide for an orderly fishery and periodic

reassessment of herring biomass. A total of 570 tons of herring was harvested in the Security Cove District in 1991 during three openings with a total of 12 hours of fishing time. The district was opened to commercial harvest for four hours on May 13. Six processors purchased 5.9 tons of sac roe herring with an average roe percentage of 9.7% Six deliveries were made by six fishermen. The second opening was for two hours on May 14. The catch totaled 25.2 tons of sac roe herring with an average roe content of 10.8% and 2 tons of bait-quality herring. Twenty-five fishermen made 30 deliveries. The third opening was for six hours on May 16. Fifty-two fishermen delivered 529.6 tons of sac roe herring with a roe content of 9.2% and 7.3 tons of bait-quality herring. The total harvest was 12.9% of the observed biomass. Fifty-two fishermen made 100 landings to six processors. Fishermen received approximately $400 per ton for 10% sac roe herring and $50 to $80 per ton for bait-quality herring. The total ex-vessel value of the harvest was approximately $208,000.

Goodnews Bay District

The 1991 herring harvest in the Goodnews Bay District totaled 263 tons. Meetings with fishermen and processors were held daily from May 19 to May 21. Commercial fishermen brought catch samples to these meeting for evaluation by industry roe technicians. On May 21, the roe content of commercial test fish samples averaged 7.8%. One four hour opening on May 22 produced a harvest of 263 tons. The catch included 258.5 tons of sac roe herring with 8.9% roe content and 4.1 tons of bait-quality herring. One hundred-three fishermen made 137 landings to two processors. The harvest was 6.0% of the post-season estimated biomass of 4,387 tons. Fishermen received approximately $400 per ton for 10% sac roe herring and $50 to $80 per ton for bait-quality herring. The total ex-vessel value of the harvest was approximately $93,000.

Cape Avinof District

At the request of the Kwigillingok IRA Council, the eastern boundary of the Cape Avinof District was extended approximately 24 miles to a point 4 miles east of the village of Kwigillingok by emergency order on May 1, 1989. In 1990, the Alaska Board of Fisheries extended the eastern boundary to the Ishkowik River (162°44'W.long.) 25 miles east of Kwigillingok.

In 1991, six commercial openings, with a total of 28 hours of fishing time, were scheduled in the Cape Avinof District. The total harvest was 240 tons of sac roe herring at 9.5% roe content and 27 tons of bait-quality herring. The district was first opened to commercial fishing for three hours on May 26. A second period of six hours was scheduled later that day. The harvest from both openings was 120.1 tons of sac roe herring with an average roe content of 9.7% and 6.4 tons of bait-quality herring. A five hour and a four hour period were scheduled for May 27. The harvest on this day was 86.5 tons of sac roe herring with a roe content of 9.5% and 8.6 tons of bait-quality herring. The district reopened on May 29 for four hours. During this period, fishermen harvested 32 tons of sac roe with a roe content of 9.0% and 2.3 tons of bait-quality herring. During the final period of fours hours on May 31, 4 tons of sac roe with 8.3% roe content and 9.7 tons of bait-quality herring were delivered.

A tender was available near Kwigillingok for the first time in the Cape Avinof District fishery. A total of 65 tons of sac roe herring with a 10.1% roe content and 3.4 tons of bait-quality herring were delivered in the Kwigillingok area.

The harvest was 12.8% of the estimated biomass. One hundred-thirty-seven fishermen made 463 deliveries to one processor. Fishermen received approximately $400 per ton for 10% sac roe herring and $50 to $80 per ton for bait-quality herring. The value of the catch to fishermen was about $94,000.

Nelson Island District

No commercial openings occurred in the Nelson Island District in 1991 because the estimated biomass of herring was less than the 2,500 ton threshold necessary for a commercial fishery.

Nunivak Island District

The 1991 herring harvest in the Nunivak Island District totaled 17.2 tons of sac roe herring with an average roe content of 7.5% and 42.3 tons of bait-quality herring. Two commercial openings for a total of 12 hours of fishing time were scheduled. The district was opened to four hours of commercial fishing on May 20. During this first period, seventeen fishermen landed 17.2 tons of sac roe herring with a roe content of 7.5% and 37.1 tons of bait-quality herring. A second opening of eight hours was scheduled for May 22. Only 5.2 tons of bait-quality herring was landed by seven fishermen during the second period.

The harvest was 1.5% of the available biomass. Fishermen received approximately $400 per ton for 10% sac roe herring and $50 to $80 per ton for bait-quality herring. Two processors paid 17 fishermen an estimated $8,500 for their catch.

Cape Romanzof District

The 1991 commercial herring season in the Cape Romanzof District consisted of three openings during May 21-23 for a total fishing time of 5 hours. The first and last periods were only 1.5 hours in length which were the shortest periods on record. During all periods, gear was restricted to one 50 fathom gillnet. Short fishing periods and gear restrictions were necessary because of limited tendering capacity and the small projected harvest for the Cape Romanzof District. The harvest totaled 526 tons of herring. The harvest consisted of 451 tons of sac roe with an average roe recovery of 8.8% and 75 tons of bait-quality herring. A total of 80 fishermen participated in the fishery. This is the lowest effort since 1985 and was 17% below the 1990 effort. Two buyers in the Cape Romanzof District paid fishermen an average of $500 per ton for 10% sac roe herring plus or minus $50 a percentage point. The average price paid for bait-quality herring (less than 6-7% roe) was $125 per ton. The total ex-vessel value of the harvest was approximately $210,000.

In coordination with the Department, commercial fishermen provided catch samples for evaluation by industry representatives prior to each opening. Since it was

not possible to obtain an inseason estimate of herring biomass based on aerial surveys, the preseason projected biomass of 3,000 tons was used to manage the fishery. The harvest was 11.7% of the postseason estimate of 4,500 tons.

Norton Sound District

The 1991 Norton Sound herring fishery opened by emergency order on May 23. A total of two gill net openings for 11 hours of fishing and two beach seine openings, the first for two hours and a second co-oped opening of approximately two hours occurred this season. The district closed on May 25. The harvest of 5,797 tons of herring was approximately 13.5% of the estimated biomass. The harvest included 5,465 tons of sac roe herring with an average roe recovery of 9.3%, 207 tons of bait-quality herring, and approximately 125 tons of herring estimated to have been wasted in abandoned gill nets.

There were 279 fishermen, consisting of 272 gillnetters and 7 beach seiners, who made at least one delivery during the season. This is the lowest effort since 1985. Fishing effort during the 1980 to 1986 period averaged 276 fishermen. Effort levels peaked in 1987 at 564 fishermen. The fishing effort since 1987 has been declining due to a moratorium of new effort which has been in effect since 1988.

Gillnet fishermen landed a total of 5,150 tons with 9.2% average roe recovery. Beach seiners landed 523 tons of herring with 10.4% roe. Fishing periods for the two fisheries were scheduled at separate times to prevent gear conflicts and enable the Department to monitor the beach seine fishery more closely. One educational gill net permit was issued by CFEC, and was fished by the Bering Straits School District Commercial Fisheries Vocational class immediately following the closure of the commercial gill net and beach seine fisheries. A total of 7.6 tons was landed on this permit and is included in the gill net total harvest.

Eight companies registered 12 processing vessels and 55 tenders to operate in Norton Sound for the 1991 season. Fishermen received approximately $422 per ton for 9.3% sac roe herring. Bait-quality herring (less than 7% roe recovery) sold for $56 per ton. The total value of the herring harvest to fishermen was approximately $2,413,636.

The commercial fishery was managed at 20% of the preseason projected biomass of 25,371 tons with 4,567 tons allocated to the gill net fishery and 507 tons allocated to the beach seine fishery.

Port Clarence District

There has not been a commercial fishery in the Port Clarence District since 1988 because buyers have not been present in the district. A permit was issued in 1991 for transport of *Macrocystis* to Brevig Lagoon for an experimental open pound project. However herring did not spawn on the *Macrocystis*.

ENFORCEMENT

In 1991, the Division of Fish and Wildlife Protection (FWP) was present in all AYK districts with the exception of the Cape Avinof District. At least 10 people with FWP were involved in Kuskokwim Bay herring fisheries. The P\V WOLSTAD, a FWP Grumman Goose, C-185 aircraft and a helicopter were used in patrolling the herring fisheries. Citations were issued for violating fishing regulations in the Kuskokwim districts patrolled by FWP personnel. These violations included fishing during a closed season and improper or no vessel registration.

Nine FWP officers were present in the Cape Romanzof District during the 1991 herring season. These officers were supported by the P\V WOLSTAD, three skiffs, one fixed-wing aircraft and one helicopter. A total of two commercial fishing citations were issued. Both commercial fishing citations were issued for fishing during a closed period. One delivery, totaling two tons of herring, was confiscated.

Fish and Wildlife Protection effort in Norton Sound consisted of two fixed-winged aircraft, a helicopter, several small boats, and the P\V WOLSTAD. There were 8 permanent, full-time FWP officers and four civilian public safety employees present. FWP officers patrolled the grounds during each opening and closure. This represents one of the best enforcement efforts in the Norton Sound fishery. Thirty citations were issued for the following violations: fishing during a closed period (both early and late), abandoning nets, improper or no vessel registration, and assault. In addition, investigations are pending on abandoned gill net gear and superexclusive use violations. A total of 21.3 tons of herring was confiscated by the State of Alaska during the 1991 season. Additional forfeitures are possible following further investigation.

OUTLOOK AND MANAGEMENT STRATEGY FOR 1992

Over the past 10 years, herring biomass has been declining in most eastern Bering Seas fishing districts due to the weak recruitment of younger age classes (ages 3-5) and reduced returns of the abundant 1977 and 1978 year classes (due to high natural mortality of older aged herring). An exception is the Norton Sound herring population which appears to be increasing in biomass. This increase may be partly due to changing aerial survey and biomass estimation techniques. However, the Norton Sound herring population has experienced an influx of young fish during years in which other Bering Sea districts have not and thus has had a different age composition and dominant year classes compared to other districts.

Projections from post-season escapement estimates, using mean rates of natural mortality and growth for each age class (Wespestad 1982; S. Fried, Alaska Department of Fish and Game, Anchorage, personal communication), indicate that the 1992 minimal spawning biomass for the northeastern Bering Sea herring stocks (Security Cove to Norton Sound) should be approximately 40,000 tons (Table 6).

Increased recruitment of ages 3 through 5-year-old Pacific herring could increase the 1991 observed biomass over projected biomass estimates in all districts. However in accordance with the AYK Region harvest policy, newly recruited age classes (age 3, 4, and 5 year-old-herring) will not be targeted by the commercial fishery.

Since methods to forecast herring returns are still being developed and reliable estimates of recruitment are not available, harvest levels will be adjusted during the season according to observed herring spawning biomass. If it is not possible to determine herring abundance using aerial survey methods, stock abundance will be assessed using information from test and commercial catches and spawn deposition observations.

Security Cove District

Herring biomass in the Security Cove District is expected to be above 1989 and 1990 levels. The 1992 projected return is 3,042 tons which would result in a 608 ton harvest at a 20% exploitation rate (Table 6). Age 5 herring are expected to dominate the return. Age 9 and older herring are expected to comprise almost half of the biomass.

Emergency order authority will be used to adjust the occurrence and length of fishing periods commensurate with stock strength, fishing effort, and spawning activity. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons or significant spawning activity is documented.

Goodnews Bay District

Herring biomass in the Goodnews Bay District is also expected to be above 1989 and 1990 levels. The 1992 projected return is 2,978 tons which would result in a harvest of 596 tons at a 20% exploitation rate (Table 6). Ages 8 and 5 herring are expected to dominate the return. Age 9 and older herring are expected to comprise approximately 50% of the biomass.

The management strategy for this district will be similar to that used for Security Cove. The season will be opened by emergency order. Commercial fishing will not be allowed until the observed biomass reaches 1,200 tons or significant spawning is observed.

Cape Avinof District

The return to the Cape Avinof District in 1992 is expected to be 1,382 tons, which at an exploitation rate of 15% would result in a 207 ton harvest (Table 6). Age 8 herring are expected to be the largest age group in the return. Age 9 and older herring are expected to comprise 47% of the return.

The 1992 Cape Avinof District commercial herring fishery will be regulated by emergency order. No commercial fishery will be allowed until the total biomass reaches 500 tons or significant spawning is observed. Commercial harvest of

Pacific herring will be up to 15% of the total spawning biomass.

Nelson Island District

The spawning biomass projected to return to the Nelson Island District during 1992 is 1,555 tons (Table 6). This is below the 2,500 ton threshold required for a commercial fishery. However, processors and fishermen are advised that management of the 1992 fishery will be based on observed biomass.

Age 8 herring are expected to be the dominant age group. Herring of age 9 and older are expected to comprise approximately 61% of the biomass in 1992. The harvest level will be maintained at 10% unless available biomass significantly exceeds the 2,500 ton threshold level.

As in 1991, the Nelson Island commercial fishery will be regulated by emergency order. To provide additional protection for the subsistence harvest of Pacific herring, the following guidelines will be followed:

1. The commercial fishery will be allowed to take up to 15% of the herring biomass, compared to up to 20% for most other fisheries having stocks of similar size and condition.

2. The commercial fishing season will be opened when a biomass of 2,500 tons or significant spawning activity is documented.

3. Periodic closures of the commercial fishery will be scheduled, during which time only subsistence fishing will be allowed.

4. Several important subsistence use areas occur throughout the district, including the waters north of Cape Vancouver. Specific areas may be closed to commercial fishing to insure the adequacy of subsistence harvests.

5. The Department will by all available means, including input from local residents, insure the adequacy of subsistence herring harvests during the commercial fishing season.

Nunivak Island District

The biomass of herring projected to return to the Nunivak Island District during 1992 is 2,249 tons (Table 6). As in 1991, the Nunivak Island District commercial herring fishery will be regulated by emergency order. Commercial harvest of Pacific herring will be up to 15% of the observed spawning biomass. If the threshold of 1,500 tons of herring or significant spawning activity is not observed, the fishery will not be opened. Age 9 and older herring are expected to comprise 82% of the return.

Cape Romanzof District

The projected return for 1992, based upon limited data, is 2,700 tons which would result in a 400 ton harvest at a 15% exploitation rate (Table 6). Age 8 herring are expected to comprise the largest age group in biomass.

Emergency order authority will be used to adjust the occurrence and length of fishing periods. Aerial biomass assessment cannot be used to determine the opening of commercial fishing due to typically poor survey conditions caused by turbid water. Therefore, spawn deposition observations and test and commercial catch rates will be used to determine timing and duration of commercial fishing periods and relative stock abundance. If stock abundance is judged to be lower or higher than the projection, the projected harvest of 400 tons will be modified accordingly.

Norton Sound District

The Norton Sound biomass may be below the 1991 level as a decrease in the return of the dominant 1982 year class is expected. The projected return is approximately 26,000 tons which at a 20% exploitation rate would result in a harvest of about 5,200 tons (Table 6). The 1992 spawning population is expected to be dominated by 10 year olds.

Inseason assessment of herring biomass will supersede projected biomass for management of the Norton Sound herring fishery except where weather prevents obtaining an inseason estimate. The beach seine harvest is, by regulation, 10% of the projected harvest or 520 tons.

The 1992 herring fishery will be opened by emergency order. The fishery will close by emergency order when up to 20% of the available Pacific herring biomass has been harvested. Varied harvest rates may be applied to individual subdistricts based on biomass distribution, roe quality, weather, and sea ice conditions.

Port Clarence District

The Department does not generally project an outlook for the Port Clarence fishery due to the lack of data on Port Clarence herring and the very limited scope of the fishery. The guideline harvest of 165 tons established by the Board of Fisheries in 1981 will determine the allowable harvest in 1992. This harvest guideline is based on two years research by the Department in both the Port Clarence and Kotzebue Districts. Even though this guideline has not appeared in the regulation book since 1984, it still represents the best estimate of harvestable biomass at this time.

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Table 1. Pacific herring harvests by domestic commercial fishermen in the northeastern Bering Sea, Alaska, 1909-1991.

Year	Herring (st)[a]									Spawn on Kelp (st)	
	Security Cove	Goodnews Bay	Cape Avinof	Nelson Island	Nunivak Island	Cape Romanzof	Norton Sound	Port Clarence	Total Harvest	Norton Sound	Total Harvest
1909-1916	-	-	-	-	-	-	-[b]	-	-	-	-
1916-1928	-	-	-	-	-	-	1,881	-	1,881	-	1,881
1929	-	-	-	-	-	-	166	-	166	-	166
1930	-	-	-	-	-	-	441	-	441	-	441
1931	-	-	-	-	-	-	86	-	86	-	86
1932	-	-	-	-	-	-	529	-	529	-	529
1933	-	-	-	-	-	-	31	-	31	-	31
1934	-	-	-	-	-	-	4	-	4	-	4
1935	-	-	-	-	-	-	15	-	15	-	15
1936	-	-	-	-	-	-	-	-	-	-	-
1937	-	-	-	-	-	-	6	-	6	-	6
1938	-	-	-	-	-	-	10	-	10	-	10
1939	-	-	-	-	-	-	6	-	6	-	6
1940	-	-	-	-	-	-	14	-	14	-	14
1941	-	-	-	-	-	-	3	-	3	-	3
1942-1944	-	-	-	-	-	-	-	-	-	-	-
1945	-	-	-	-	-	-	-	-	-	-	-
1946	-	-	-	-	-	-	-	-	-	-	-
1947-1963	-	-	-	-	-	-	-	-	-	-	-
1964	-	-	-	-	-	-	20	-	20	-	20
1965	-	-	-	-	-	-	-	-	-	-	-
1966	-	-	-	-	-	-	12	-	12	-	12
1967	-	-	-	-	-	-	-	-	-	-	-
1968	-	-	-	-	-	-	-	-	-	-	-
1969	-	-	-	-	-	-	2	-	2	-	2
1970	-	-	-	-	-	-	8	-	8	-	8
1971	-	-	-	-	-	-	20	-	20	-	20
1972	-	-	-	-	-	-	17	-	17	-	17
1973	-	-	-	-	-	-	35	-	35	-	35
1974	-	-	-	-	-	-	2	-	2	-	2
1975	-	-	-	-	-	-	-	-	-	-	-
1976	-	-	-	-	-	-	9	-	9	-	9
1977	-	-	-	-	-	-	11	-	11	<1	11
1978	286	-	-	-	-	-	15	-	301	4	305
1979	424	90	-	-	-	-	1,292	-	1,806	13	1,819
1980	697	448	-	-	-	611	2,452	-	4,208	24	4,232
1981	1,173	657	-	-	-	720	4,371	-	6,921	47	6,968
1982	813	486	-	-	-	657	3,933	-	5,889	38	5,927
1983	1,073	435	-	-	-	816	4,582	-	6,906	29	6,935
1984	335	717	-	-	-	1,185	3,662	-	5,899	19[c]	5,918
1985	733	724	-	977	358	1,299	3,548	-	7,639	-	7,639
1986	751	557	-	886	511	1,865	5,194	-	9,764	-	9,764
1987	313	321	-	923	414	1,342	4,082	146	7,541	-	7,541
1988	324	483	348	775	-	1,119	4,672	80	7,801	-	7,801
1989	554	616	129	233	116	926	4,771	-	7,345	-	7,345
1990	234	455	50	-	-	329	6,439	-	7,507	-	7,507
1991	570	263	267	-	59	526	5,672	-	7,357	-	7,357

[a] Pre-1964 harvest primarily in summer and fall for food; post 1964 harvest primarily in spring for sac roe. Wastage included.

[b] Fishery occurred some years but harvest data unavailable.

[c] Additional 3 st harvested from imported kelp (Macrocystis sp) not included.

Table 2. Estimated biomass and commercial harvest of Pacific herring in northeastern Bering Sea fishing districts, Alaska, 1985-1991.

Year	District	Estimated Biomass (st)	Harvest (st)			% Harvest by Gear				Estimated Value ($ x1,000)	Exploitation Rate (%)
			Catch	Waste	Total	Gill Net	Purse Seine	Beach Seine	Roe %		
1991	Security Cove	4,434	570	0	570	100	0	0	9.3	208	12.9
	Goodnews Bay	4,387	263	0	263	100	0	0	8.9	93	6.0
	Cape Avinof	2,083	267	0	267	100	0	0	9.5	94	12.8
	Nelson Is.	2,385	-	-	-	100	0	0	-	-	-
	Nunivak Is.	3,903	59	0	59	100	0	0	7.4	9	1.5
	Cape Romanzof	4,500	526	0	526	100	0	0	8.8	210	11.7
	Norton Sound	42,854	5,672	125	5,797	91	0	9	9.3	2,414	13.5
	Total	64,546	7,357	125	7,482	93	0	7	9.2	3,028	11.4
1990	Security Cove	2,650	234	0	234	100	0	0	8.7	94	8.8
	Goodnews Bay	2,577	455	0	455	100	0	0	12.2	314	17.7
	Cape Avinof	2,020[a]	50	0	50	100	0	0	12.0	35	2.5
	Nelson Is.	2,705	-	-	-	100	0	0	-	-	-
	Nunivak Is.	422	-	-	-	100	0	0	-	-	-
	Cape Romanzof	4,500	329	0	329	100	0	0	8.4	155	7.3
	Norton Sound	39,384	6,379	60	6,439	95	0	5	8.8	3,606	16.0
	Total	54,258	7,447	60	7,507	95	0	5	9.0	4,204	13.8
1989	Security Cove	2,830	554	0	554	100	0	0	9.4	265	19.6
	Goodnews Bay	4,040	616	0	616	100	0	0	8.4	335	15.2
	Cape Avinof	2,780[a]	129	0	129	100	0	0	8.0	54	18.7
	Nelson Is.	3,320	222	11	233	100	0	0	8.5	57	7.0
	Nunivak Is.	620	116	0	116	100	0	0	9.4	42	18.8
	Cape Romanzof	4,400	926	0	926	100	0	0	9.3	486	21.0
	Norton Sound	25,980	4,741	30	4,771	91	0	8	9.2	2,322	18.3
	Total	43,970	7,304	41	7,345	95	0	5	9.0	3,561	16.7
1988	Security Cove	4,910	324	0	324	100	0	0	9.3	362	6.6
	Goodnews Bay	4,480	483	0	483	100	0	0	8.0	463	10.7
	Cape Avinof	4,110	348	0	348	100	0	0	8.6	264	8.5
	Nelson Is.	7,150	775	0	775	100	0	0	9.2	713	10.8
	Nunivak Is.	2,800[a]	-	-	-	-	-	-	-	-	-
	Cape Romanzof	6,600	1,119	0	1,119	100	0	0	9.1	1,018	17.0
	Norton Sound	33,920	4,672	0	4,672	96	0	4	9.0	3,864	13.8
	Port Clarence	790	80	0	80	30	70	0	8.2	43	10.2
	Total	64,760	7,801	0	7,801	97	<1	2	9.0	6,727	12.0
1987	Security Cove	2,300	313	0	313	100	0	0	9.7	242	13.4
	Goodnews Bay	2,000[a]	321	0	321	100	0	0	7.3	133	16.0
	Nelson Is.	8,100	923	0	923	100	0	0	9.2	661	11.4
	Nunivak Is.	4,400[a]	414	0	414	100	0	0	7.8	231	9.2
	Cape Romanzof	7,200	1,342	0	1,342	100	0	0	8.9	1,000	18.6
	Norton Sound	32,400	4,082	0	4,082	92	0	8	8.6	2,613	12.6
	Port Clarence	900	146	<1	146	<1	100	0	6.6	77	15.6
	Total	57,300	7,541	<1	7,541	94	2	4	8.6	4,957	13.1
1986	Security Cove	3,700[a]	751	0	751	100	0	0	11.2	535	20.3
	Goodnews Bay	3,000[a]	557	0	557	100	0	0	10.4	325	18.1
	Nelson Is.	7,300[a]	886	0	886	100	0	0	10.3	428	12.1
	Nunivak Is.	6,000	511	0	511	100	0	0	10.1	213	8.5
	Cape Romanzof	7,500	1,865	0	1,865	100	0	0	9.2	1,142	24.9
	Norton Sound	28,100	5,196	0	5,196	96	0	4	9.6	2,900	18.5
	Total	55,600	9,764	0	9,764	98	0	2	9.7	5,543	17.6
1985	Security Cove	4,900[a]	703	30	733	100	0	0	10.1	355	15.0
	Goodnews Bay	4,300[a]	724	0	724	100	0	0	8.7	309	16.8
	Nelson Is.	9,500[a]	977	0	977	100	0	0	10.6	527	10.3
	Nunivak Is.	5,700[a]	358	0	358	100	0	0	8.9	146	6.3
	Cape Romanzof	7,000	1,299	0	1,299	100	0	0	8.3	550	18.6
	Norton Sound	20,000	3,548	0	3,548	95	0	5	9.9	1,438	17.7
	Total	51,400	7,609	30	7,639	98	0	2	9.6	3,325	14.8

[a] Inseason biomass estimate from poor aerial survey, therefore projected biomass used.

Table 3. Number of buyers and fishermen participating in northeastern Bering Sea Pacific herring fisheries, Alaska, 1986-1991.

Year	District	Number of Buyers	Number of Fishermen		
			Gill Net	Seine[a]	
				Purse	Beach
1991	Security Cove	6	52	-	-
	Goodnews Bay	2	103	-	-
	Cape Avinof	1	137	-	-
	Nelson Island	-	-	-	-
	Nunivak Island	2	17	-	-
	Cape Romanzof	2	80	-	-
	Norton Sound	8	272	-	7
1990	Security Cove	9	52	-	-
	Goodnews Bay	3	126	-	-
	Cape Avinof	1	101	-	-
	Nelson Island	-	-	-	-
	Nunivak Island	-	-	-	-
	Cape Romanzof	4	95	-	-
	Norton Sound	8	357	-	8
1989	Security Cove	8	110	-	-
	Goodnews Bay	6	138	-	-
	Cape Avinof	3	147	-	-
	Nelson Island	4	162	-	-
	Nunivak Island	3	45	-	-
	Cape Romanzof	6	115	-	-
	Norton Sound	9	351	-	6
1988	Security Cove	4	31	-	-
	Goodnews Bay	6	60	-	-
	Cape Avinof	1	98	-	-
	Nelson Island	7	174	-	-
	Nunivak Island	-	-	-	-
	Cape Romanzof	6	113	-	-
	Norton Sound	11	343	-	6
	Port Clarence	1	6	1	-
1987	Security Cove	8	65	-	-
	Goodnews Bay	4	117	-	-
	Nelson Island	9	235	-	-
	Nunivak Island	4	61	-	-
	Cape Romanzof	9	157	-	-
	Norton Sound	12	559	-	22
	Port Clarence	2	1	3	-
1986	Security Cove	11	88	-	-
	Goodnews Bay	5	104	-	-
	Nelson Island	4	163	-	-
	Nunivak Island	5	36	-	-
	Cape Romanzof	5	97	-	-
	Norton Sound	10	319	-	4

[a] Gear prohibited in all districts except Norton Sound and Port Clarence.

Table 4. Pacific herring subsistence harvest (st) and effort data from selected northeastern Bering Sea areas, Alaska, 1977-1991.[a]

Village	Year														
	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Nelson Island															
Tununak	57	38	34	65	40	48	94	-	43	63	48	49	47	54	21
Umkumiut	3	11	8	3	10	0	-	-	-	-	-[c]	-[c]	-[c]	-[c]	-[c]
Toksook Bay	21	37	51	29	14	35	-	-	46	70	51	58	52	46	40
Nightmute	-	-	-	-	-	-	-	-	3[a]	21	15	16	15	18	8
Newtok	-	-	-	-	-	-	-	-	7[a]	13	10	12	10	8	1
Total	81	86	93	97	64	83	94	-	99	167	124	136	124	126	70
Number of Fishing Families	90	83	54	70	93	65	43	-	65[b]	72[b]	96	104	-[b]	100	85
Nunivak Island															
Mekoryuk	-	-	-	-	-	-	-	-	<1	<1	-	-	-	5	4
Number of Fishing Families	-	-	-	-	-	-	-	-	11	6[b]	-	-	-	19	20
Other Kuskokwim Delta															
Chefornak	-	-	-	-	-	-	-	-	13[b]	-	14	-	-	-	-
Kipnuk	-	-	-	-	-	-	-	-	9	-	14	-	-	-	-
Kongiganak	-	-	-	-	-	-	-	-	3	2[b]	-	-	-	-	-
Kwigillingok	1	-	8	13	-	13	-	-	5	-	-	-	-	-	-
Total	1	-	8	13	-	13	-	-	30	2	28	-	-	-	-
Number of Fishing Families	9	-	22	19	-	21	-	-	55[b]	12[b]	49	-	-	-	-
Yukon Delta															
Scammon Bay	-	1	6	3	8	4	3	4	2	2	1	2	1	<2	2
Chevak	<1	-	2	4	2	2	1	3	2	1	1	2	<1	<1	1
Hooper Bay	2	4	3	4	4	5	5	4	4	4	1	3	1	6	1
Total	<3	5	11	11	14	11	9	11	8	7	3	7	2	9	4[d]
Number of Fishing Families	30	29	84	61	46	43	37	47	44	41	39	30	19	31	30[d]

[a] Subsistence survey results are believed to accurately reflect harvest trends, however, reported catches reflect minimum figures since all fishermen cannot be contacted.
[b] Fishing families were not interviewed or only a portion of fishing families were interviewed as catch was enumerated while on drying racks.
[c] Umkumiut effort included with Tununak.
[d] Preliminary estimates.

Table 5. Summary of Pacific herring commercial harvest by fishing period for northeastern Bering Sea fishing districts, Alaska, 1991.

District	Subdistrict Section/Area	Gear	Period	Date	Time	Total hours	Harvest (st)
Security Cove	Entire	GN	1	5/13	1900-2300	4.0	5.9
			2	5/14	1530-1730	2.0	27.2
			3	5/16	1800-2400	6.0	536.9
					Total	12.0	570.0
Goodnews Bay	Entire	GN	1	5/22	1200-1600	4.0	262.7
					Total	4.0	262.7
Cape Avinof	Entire	GN	1	5/26	1000-1300	3.0	21.1
			2	5/26-7	1900-0100	6.0	105.4
			3	5/27	0900-1400	5.0	61.8
			4	5/27-8	2000-0200	6.0	33.3
			5	5/29	1100-1500	4.0	31.8
			6	5/31	1200-1600	4.0	13.7
					Total	28.0	267.1
Nelson Island	No Commercial Opening						
Nunivak Island	Entire	GN	1	5/20	1230-1630	4.0	54.3
			2	5/22	1130-1930	8.0	5.2
					Total	12.0	59.5
Cape Romanzof	Entire	GN	1	5/21	2100-2230	1.5	112.8
			2	5/22	2130-2330	2.0	225.9
			3	5/23	2230-2400	1.5	187.3
					Total	5.0	526.1
Norton Sound	SD 2, 3	GN	1	5/24	1700-1900	2.0	1,982.7
	SD 2, 3		2	5/25	1100-1800	7.0	3,159.6
					Total	9.0	5,149.9[a,b]
Norton Sound	SD 2, 3	BS	1	5/23	1330-1530	2.0	369.5
	SD 2, 3		2	5/25	0900-1100	2.0	152.2
					Total	4.0	521.7
Port Clarence	No Commercial Opening						

[a] Includes 21.3 st confiscated by the Alaska Department of Public Safety. Also includes 7.6 st harvested on 5/27-28 by educational permit.

[b] Does not include an estimated wastage of 125.0 st in abandoned gill nets.

Table 6. Projections of Pacific herring spawning biomass and harvest for commercial fishing districts in the northeastern Bering Sea, Alaska, 1992.

District	1992 Projection[a]			
	Biomass(st)	Threshold	Harvest(st)	Exploitation Rate (%)
Security Cove	3,042	1,200	608	20
Goodnews Bay	2,978	1,200	596	20
Cape Avinof	1,382	500	207	15
Nelson Island	1,555	2,500	-[b]	
Nunivak Island	2,249	1,500	337	15
Cape Romanzof	2,700[c]	1,500	400	15
Norton Sound	26,069	7,000	5,214	20
Port Clarence	-	-	165[d]	-

[a] Preseason projection. Biomass and harvest may be adjusted based on inseason estimates.
[b] Projected biomass is below minimum for commercial harvest; fishery will not be opened unless threshold biomass is observed.
[c] Projection from estimated 1991 relative biomass which was based on 1987 aerial survey and 1991 spawn deposition, age composition, and performance of commercial and test fisheries.
[d] Harvest guideline of 165 st (150 mt).

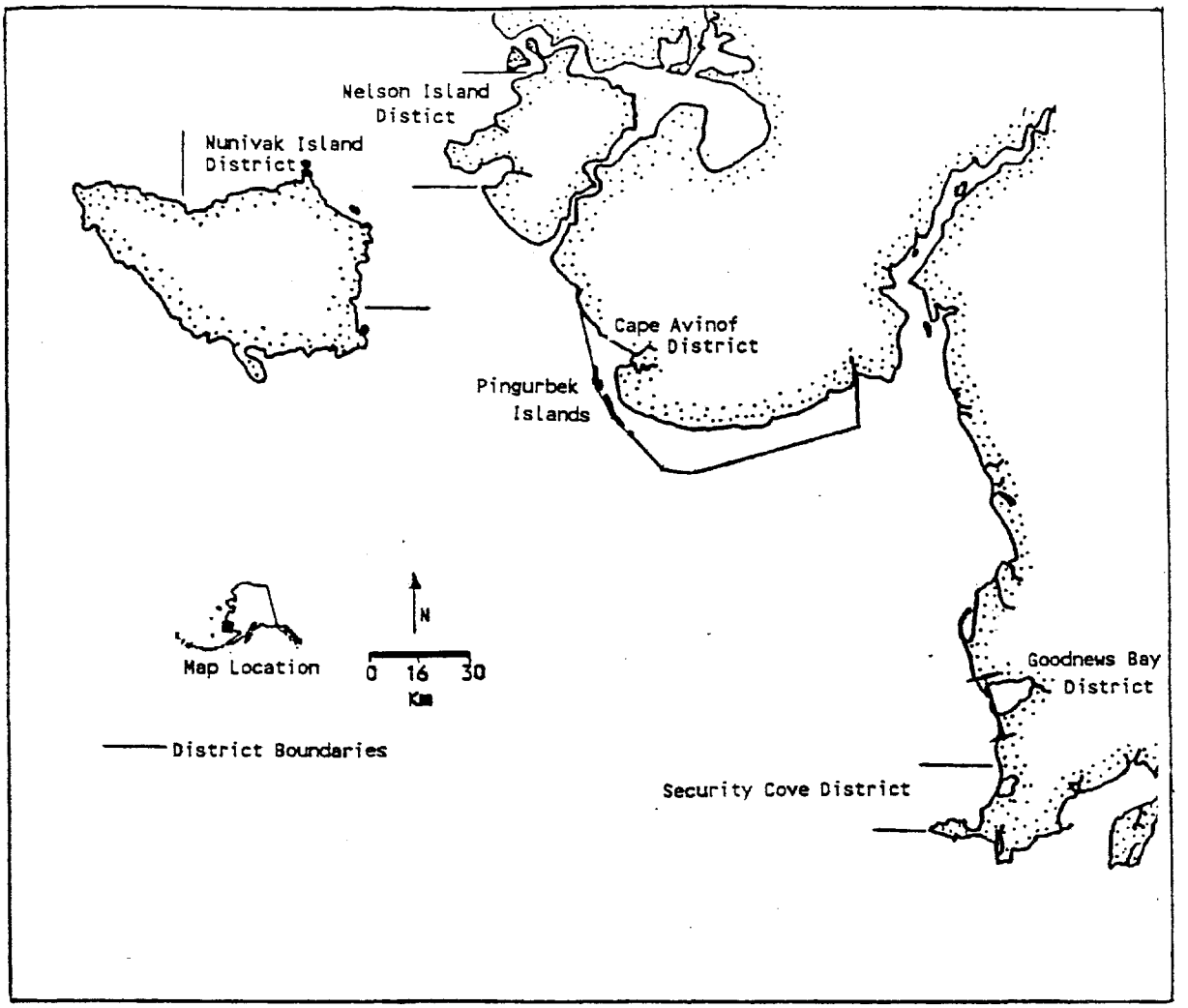

Figure 1. Security Cove, Goodnews Bay, Nelson Island, Nunivak Island, and Cape Avinof Pacific herring commercial fishing districts in the northeastern Bering Sea, Alaska

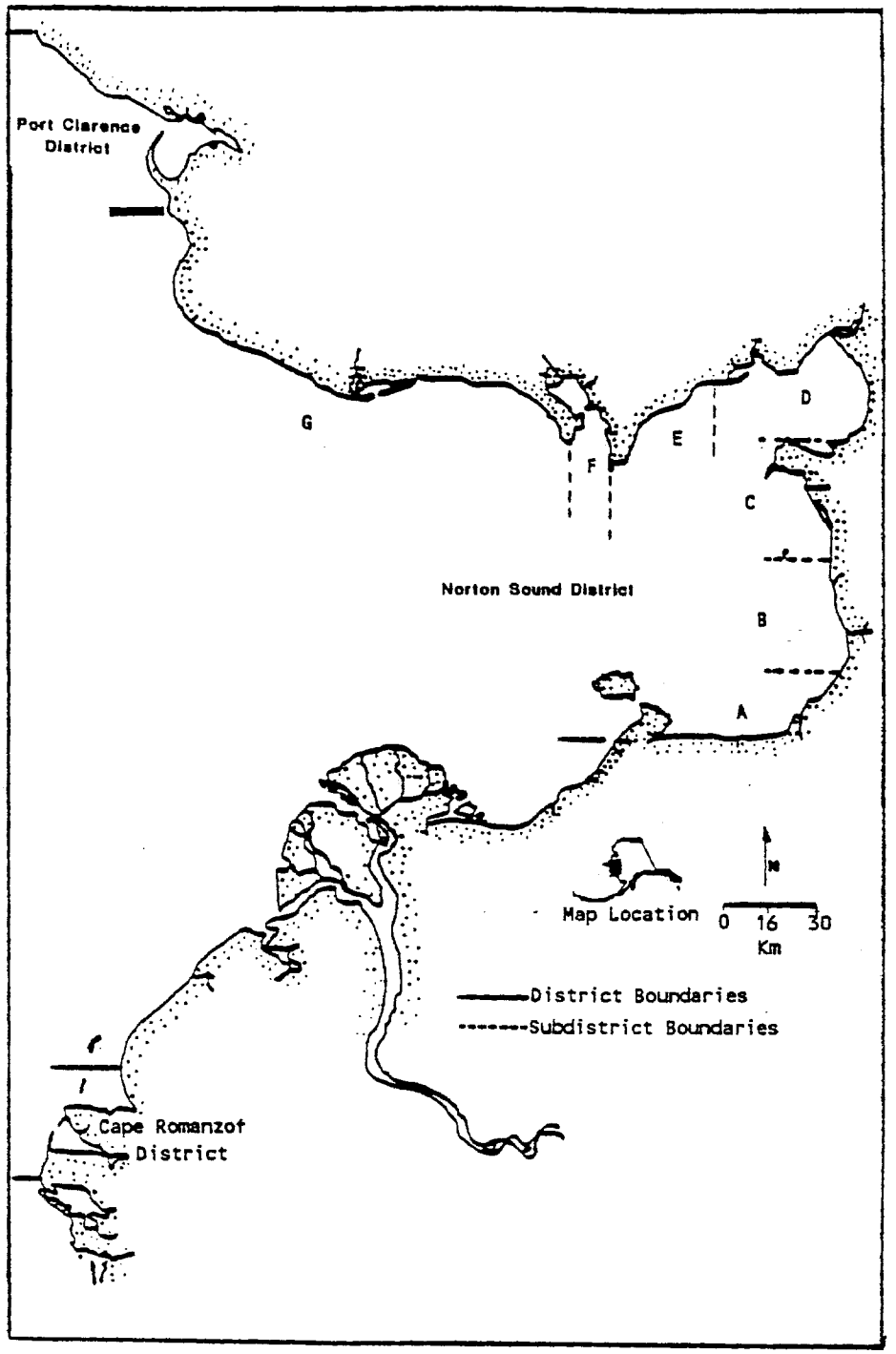

Figure 2. Cape Romanzof, Norton Sound, and Port Clarence Pacific herring commercial fishing districts, in the northeastern Bering Sea, Alaska

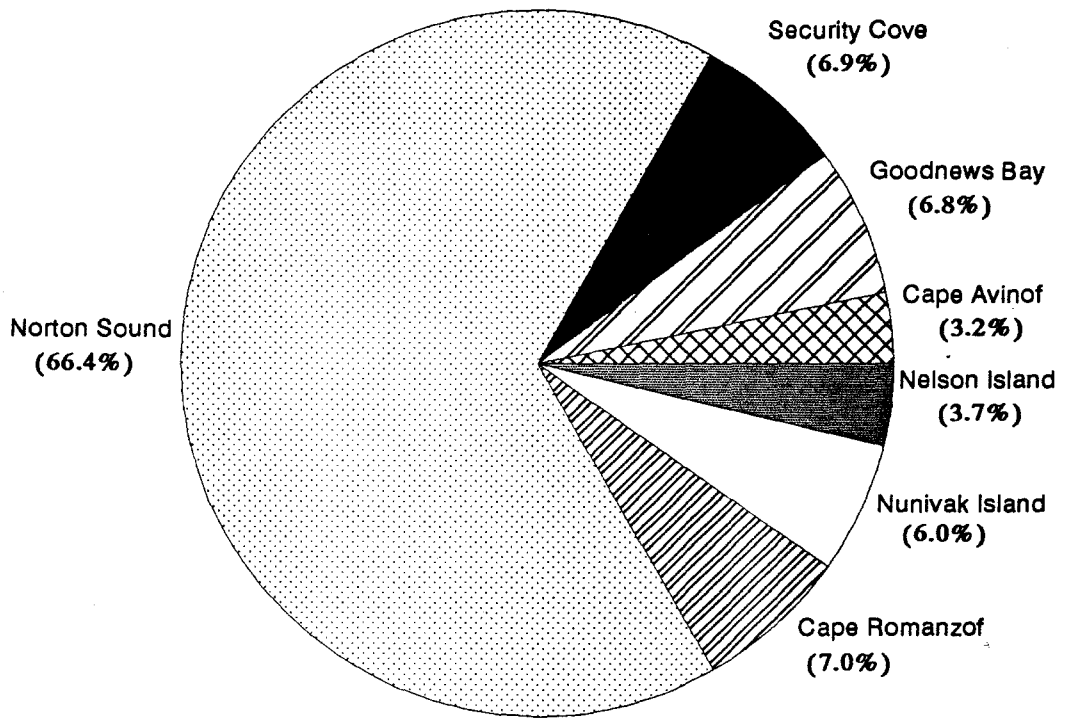

Figure 3. Pacific herring spawning biomass distribution by commercial fishing district, Arctic–Yukon–Kuskokwim Region, Alaska, 1991.

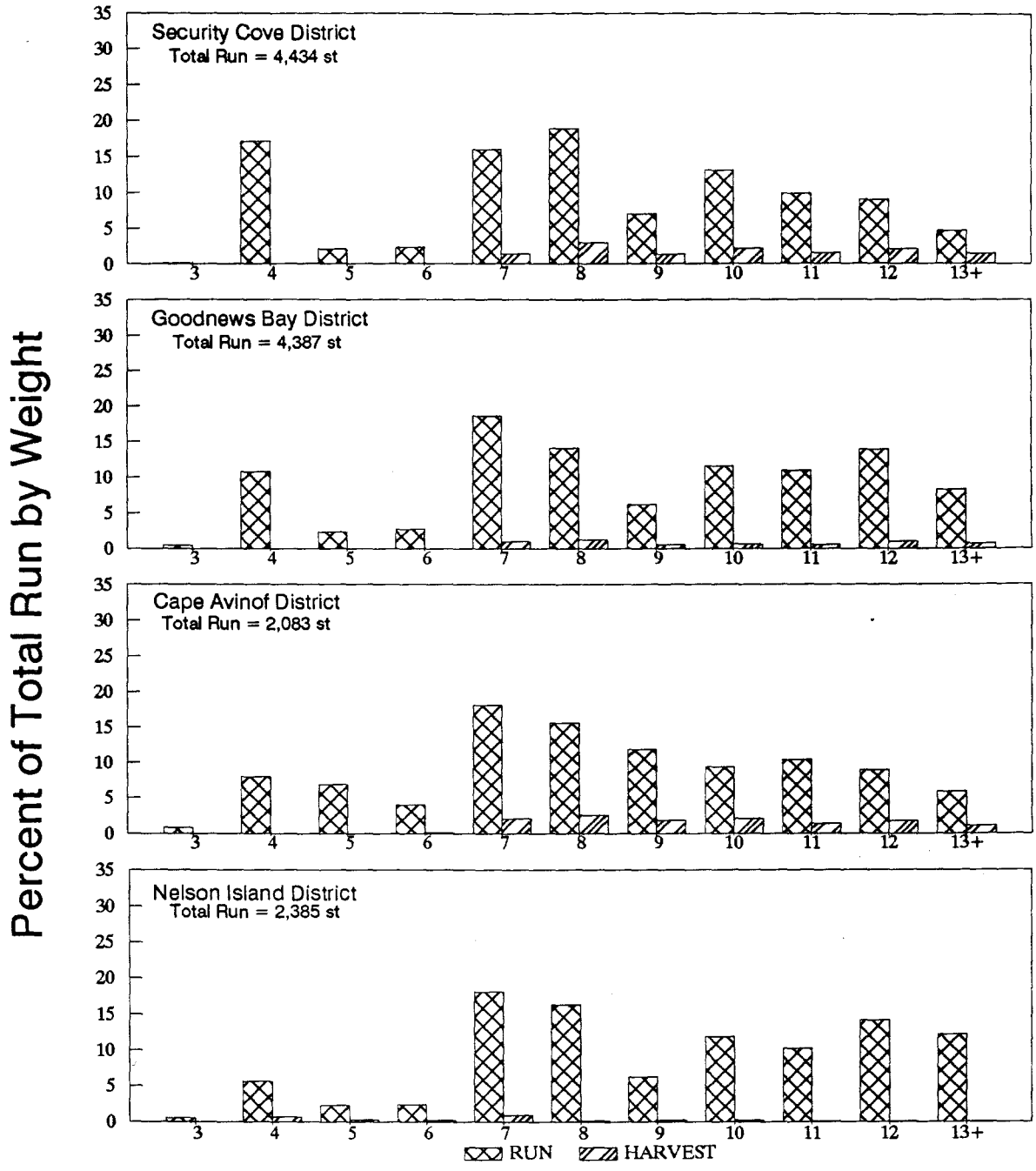

Figure 4a. Age composition of Pacific herring in spawning populations and commercial harvests for commercial fishing districts within the Arctic–Yukon–Kuskokwim Region, Alaska, 1991 (Nelson Island is subsistence harvest).

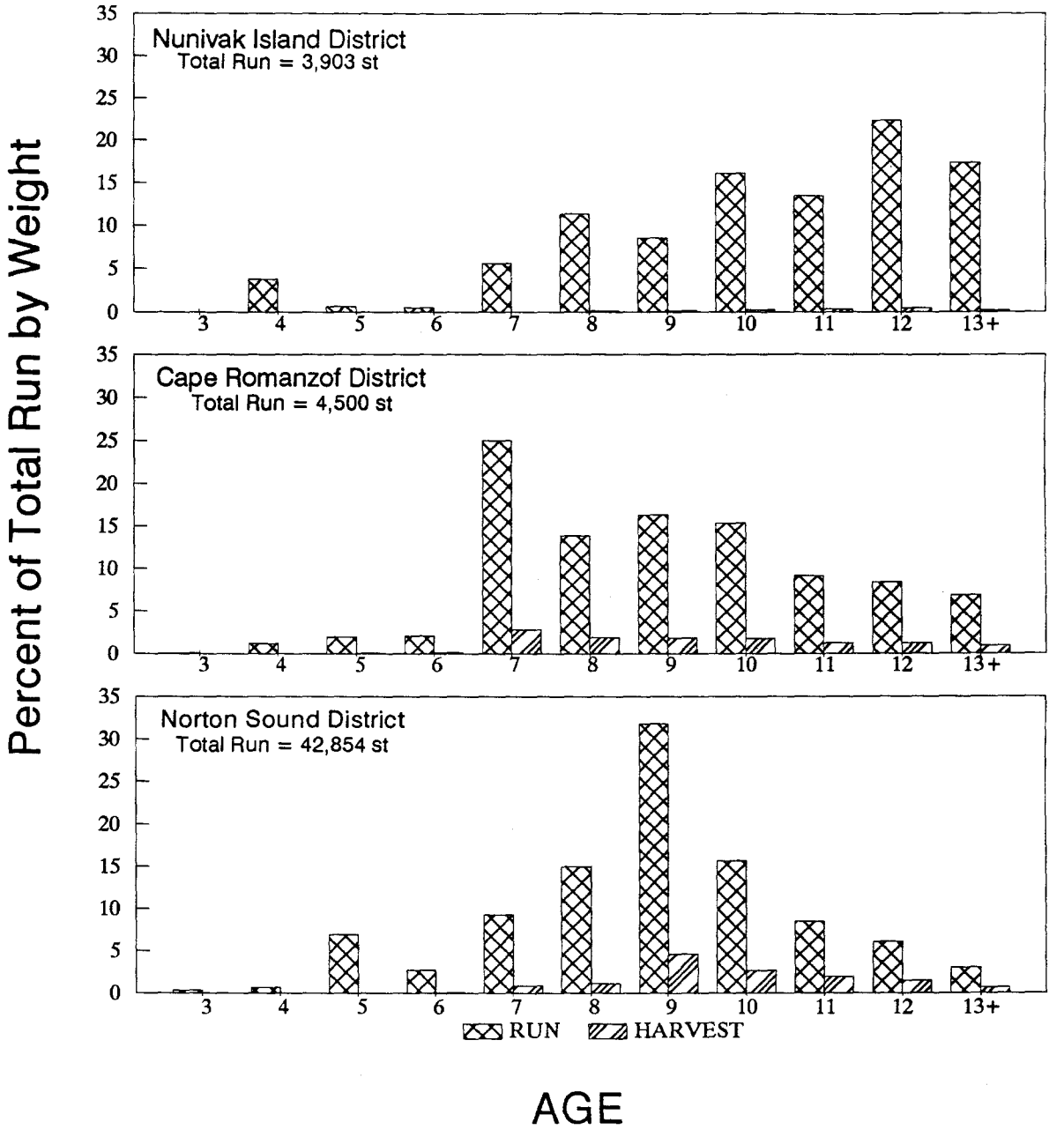

Figure 4b. Age composition of Pacific herring in spawning populations and commercial harvests for commercial fishing districts within the Arctic–Yukon–Kuskokwim Region, Alaska, 1991.

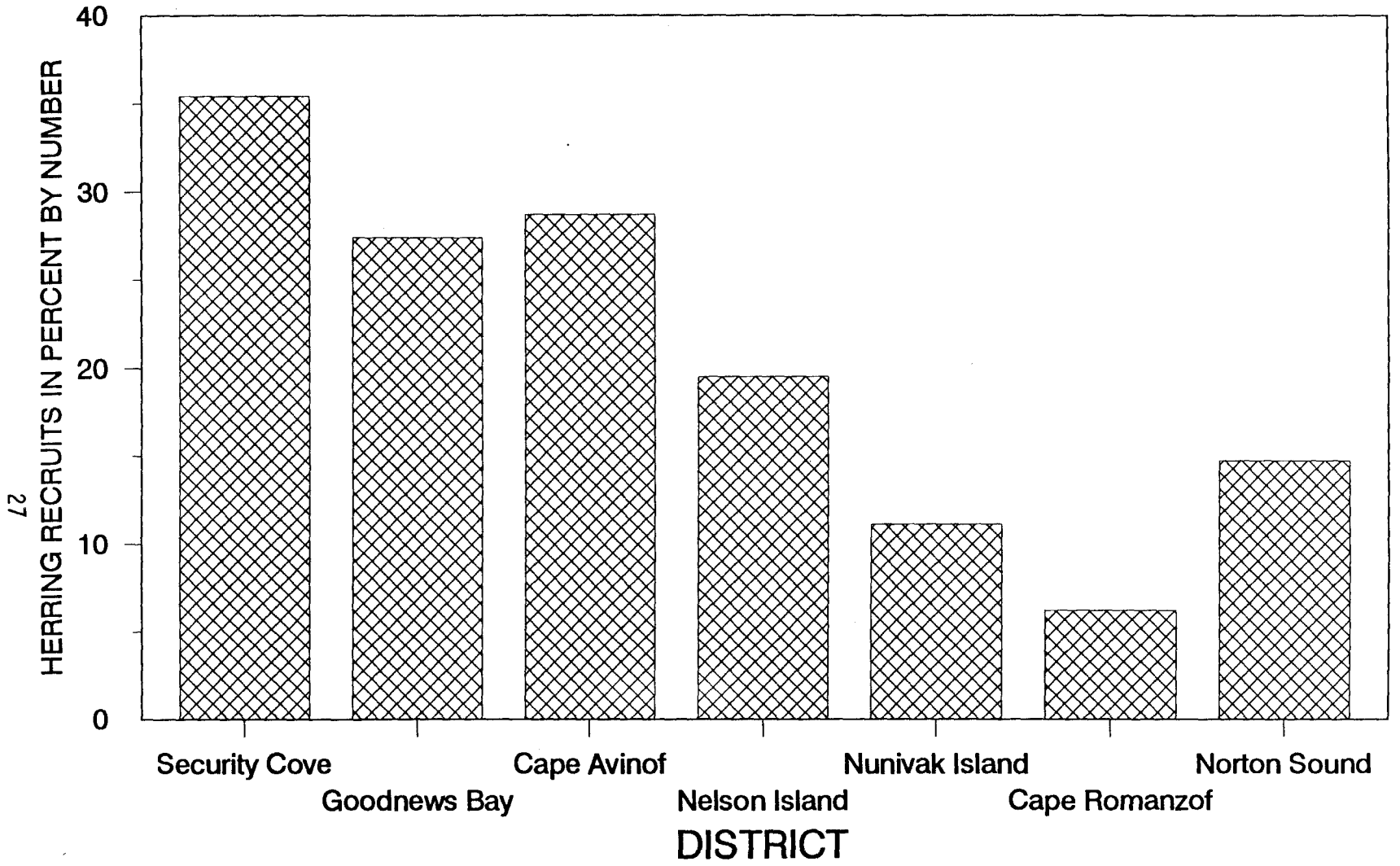

Figure 5. Herring recruitment (ages 2,3,4,5) in commercial fishing districts in the Arctic-Yukon-Kuskokwim Region, Alaska, 1991.